

Mathemat. vol 8.

A

DISSERTATION
ON THE
VALUE OF LIFE ANNUITIES,
DEDUCED FROM
GENERAL PRINCIPLES,

Clearly demonstrated and particularly applied to the
SCHEMES of the LAUDABLE and AMICABLE
SOCIETIES of ANNUITANTS, for the
BENEFIT OF AGE;

WITH
TABLES
Adapted to their several Rates and Modes of Admission;
SHEWING AT SIGHT,

The real Value that ought to be given by Persons of any Age
for the Annuity promised by those Societies; and also the
Annuity that each Member ought to be entitled to, ac-
cording to his respective Payments.

TO WHICH ARE ADDED,
All the TABLES necessary for Calculations of this Kind.

By W. BACKHOUSE. *K*

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M DCC LXXVIII.

DISSEMINATION

OF THE

WHITE PAPER

ON THE

GENERAL PRINCIPLES

OF THE

ARTS AND

MANUFACTURES

OF THE

UNITED STATES

OF AMERICA

IN THE

YEAR 1800

BY

W. B. CHURCH

OF THE

UNITED STATES

OF AMERICA



THE P R E F A C E.

A GENERAL opinion has always prevailed, that any conclusion drawn from calculations, founded on principles so unstable as those on the duration of life, must ever keep pace with the instability of that data which furnish the enquiry.

And since the duration of life is a matter immediately under the influence of Divine Agency, for wise purposes kept secret from human knowledge, it is but a natural inference, to suppose the result of any enquiry depending thereon, must ever be fruitless and vain.

This, I say, being the general received opinion, it no longer remains a matter of surprise, to find so little regard paid to, and still less belief put in, calculations of this nature, where the duration of life is their first principle.

But if we examine more attentively into this matter, it will be found, that these researches do not pretend to fathom the depths of Infinite Wisdom, and fix a certain criterion to the duration of any particular life, but only take the probability of its duration,

vi. The P R E F A C E.

duration, as gathered from observations on the bills of mortality of cities and great towns, where such bills have been kept.

And this probability, when applied to societies and large bodies of men, will come very near to measure the mean duration of life in those societies, and the larger they are, the nearer will this probability approach to the true measure; till at last, if we conceive a society as large as the place from whence the observations were made (and under the same circumstances with respect to any influence on health) this probability would then just measure the duration of life in that society collectively considered. It follows from hence, that the smaller a society is, the further will this probability recede from the true measure of life; till at last, if we conceive a society diminished to one person, this probability will then only shew the number of chances that he has to live longer than the mean age of man, or die before he attains to it. And seeing, that from the whole race of mankind, there are as many die before they attain to this mean age, as those who live beyond

beyond it, it is therefore sufficiently manifest, that the number of chances for any one person's living longer than here prescribed, must be equal to the number of chances for his dying before.

Should any person yet entertain a doubt about the rationality of this principle (on which the whole doctrine of annuities on life depends) I shall for ever despair of educing any argument sufficient to convince him, and therefore must leave it to his own incredulity.

Having established this principle, it would be needless to say any thing on the utility, or execution of the following sheets, since the first is universally allowed, and the motive that gave birth to the design, will (it is presumed) be a sufficient apology for any inaccuracy that may be found in the last: not that I am sensible of any that are material, but on the contrary, where it seemed most interesting to my Reader, I have been more solicitously careful, not only in the accuracy of calculation, but also in the perspicuity of expression; all which I humbly submit to the candour and unprejudiced discernment of the Public.

A D.

ADVERTISEMENT.

IT is necessary to acquaint the Reader, that in the following calculations, where recourse is had to the tables, for the probability of the duration of life, and the value of an annuity of 1l. on a single life, I have always made use of Tables II and III, being, in my opinion, best adapted to this purpose; but for the sake of these who prefer those deduced from the bills of mortality of London, by Mr. Simpson, I have added Tables IV and V.

Thames Street,
Saturday, May 9, 1778.

W. B.

ALGEBRAIC CHARACTERS.

AS the matter comprised in the following sheets, could not be treated in so clear and perspicuous a manner, nor become so generally useful, without having recourse to an algebraic notation; it will be proper, for the benefit of those unacquainted with the first principles of that science (and who wish to try the truth of the following calculations) to give the signification of the characters here made use of, together with their explanation.

THE CHARACTERS HERE MADE USE OF.

$+$ *more*, being the sign of Addition. Thus $a+b$ signifies that b is to be added to a .

— *less*, being the sign of Subtraction. Thus $a - b$ signifies that b is to be subtracted from a .

\times multiplied by, being the sign of Multiplication. Thus $a \times b$ signifies that a and b are

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are to be multiplied together. Likewise ab signifies the same thing. All letters joined together in algebraic notation, signify a multiplication,

\div *divided by*, being the sign of Division. Thus $a \div b$ signifies that a is divided by b , and $\frac{a}{b}$ signifies the same thing,

$=$ *equal to*, being the sign of equality. Thus $a + b = 2d$, signifies that $a + b$ equal to $2d$.

NOTATION.

In the notation of algebraic quantities, any letter of the alphabet may be put to denote, or represent any Number, or Quantity whatsoever. But writers on this subject generally choose the first of the alphabet to denote given, or known Quantities; and the last for unknown Quantities.

For general forms it is common to put the Capitals.

Ex-

EXPLANATION.

If a denote 12, and b denote 4, then
 $a+b=12+4=16$. $a-b=12-4=8$. $a \times b$, or
 $ab=12 \times 4=48$. $a \div b$, or $\frac{a}{b}=\frac{12}{4}=3$.

If $A=20$, $B=10$, then $\frac{A}{A+B}=\frac{20}{20+10}=\frac{20}{30}$
 $=\frac{2}{3}$. $\frac{B}{A+B}=\frac{10}{20+10}=\frac{10}{30}=\frac{1}{3}$.

If $a=4$, $b=6$, $c=8$ and $d=10$, then
 $\frac{a}{a+b} \times \frac{c}{c+d}=\frac{4}{4+6} \times \frac{8}{8+10}=\frac{4}{10} \times \frac{8}{18}=
 $\frac{32}{180}=\frac{8}{45}$.$

If $B=6$, $N=4$, $P=2$, $V=3$ and $n=10$, then
 will $B \times \frac{NPV}{n}=6 \times \frac{4 \times 2 \times 3}{10}=6 \times \frac{24}{10}=\frac{144}{10}=\frac{72}{5}$.

LAWS of CHANCE.

IN order to a perfect understanding of the Tables for determining the probability of the duration of life, it will be necessary to premise the leading principles of the Nature and Laws of Chance.

DEFINITION I.

The probability of an Event happening is as the ratio of the chances by which it may happen, to all the chances by which it may either happen or fail.

EXAMPLE I.

Suppose it were required to express the probability of throwing an ace at the first throw with a single die.

In a die there are six faces or sides, it is manifest that it may fall six different ways, so that there are six chances whereby it may either happen or fail, and only one of these faces, i. e. the ace, whereby it may happen; the probability
required

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required will therefore be $\frac{1}{2}$, and that of the contrary $\frac{1}{2}$.

Or, more generally thus, let A be the number of chances whereby an Event may happen, and B those whereby it may fail; the probability of its happening will be $\frac{A}{A+B}$, and that of its failing $\frac{B}{A+B}$.

COROLLARY I. Hence it appears that the probability of an Event happening $+$ by that of its failing $= 1$.

COROLLARY II. Therefore, if either the probability of the happening or failing of an Event be given; the other is also known, being the difference of that from unity.

EXAMPLE II.

Suppose it were required to throw either ace, or duce at the first throw with a single die; what is the probability?

The number of chances for both happening and failing are six as before, but either ace or
duce

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duce may come up whereby it may happen, so that the probability required will, in this case, be $\frac{2}{3} = \frac{1}{3}$, and that of the contrary $\frac{4}{6} = \frac{2}{3}$.

Or by putting $A=2$ the number of chances for its happening, and $B=4$ those for its failing, you have $\frac{A}{A+B}$ and $\frac{B}{A+B}$, the general expressions for the happening and failing of an Event respectively, equal to $\frac{2}{2+4} = \frac{2}{6} = \frac{1}{3}$, and $\frac{4}{2+4} = \frac{4}{6} = \frac{2}{3}$.

DEFINITION II.

The expectation on an Event, is considered as the present certain value, or worth of whatever sum or thing is depending on the happening of that Event; and is compounded of that sum, and the probability of obtaining it.

COROLLARY. Therefore, if the expectation on an Event be divided by the value of the thing expected on the happening of that Event; the quotient will be the probability of happening.

Ex.

EXAMPLE I.

Suppose *A* to throw once with a single die, on condition that if an ace comes up, he shall be entitled to 20s. what is his expectation before he throws? Then, because the probability of throwing an ace is $\frac{1}{6}$ (Exam. I. Def. I.) his expectation will be $\frac{1}{6}$ of 20s. or $\frac{20}{6} = \frac{10}{3} = 3\text{s. } 4\text{d.}$

EXAMPLE II.

Suppose, as before, that *A* throws once with a single die, on this condition, that if he throws either ace or deuce, he shall be entitled to the sum of 20s. what will be his expectation; or, in other words, what is his chance worth?

The probability of his throwing either ace or deuce is $\frac{2}{6}$ (Exam. II. Def. I.) therefore his chance in this case is worth $\frac{2}{6}$ of 20s. or 6s. 8d.

QUESTION.

Suppose it were required to find the probability that two assigned Events shall both happen.

SOLUTION.

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SOLUTION.

Let the probability of the happening of the first be denoted by $\frac{a}{a+b}$, and that of the second by $\frac{c}{c+d}$; and suppose the happening of both these Events to entitle a person B to the sum S ; now if the first of these should happen, it is manifest, that, from that time till the second is determined, the expectation of B will be $\frac{c}{c+d} \times S$ (Def. II.) or worth $\frac{c}{c+d}$ part of S : but the probability of getting into this circumstance, or being entitled to the value $\frac{c}{c+d} \times S$, being only $\frac{a}{a+b}$, his expectation therefore, before either of these Events are decided, can only be $\frac{a}{a+b}$ part of $\frac{c}{c+d} \times S$, or $\frac{a}{a+b} \times \frac{c}{c+d} \times S$, and therefore the required probability of receiving the sum S will be $\frac{a}{a+b} \times \frac{c}{c+d}$; i. e. the probability that any two assigned Events shall both happen, will be equal to the product of the probabilities of these Events happening, considered separately.

QUES.

QUESTIONS CONCERNING THE PROBABILITY OF LIFE.

QUESTION I.

SUPPOSE it were required to find the probability that a person 40 years of age, lives 10 years longer, or attains to the age of 50.

SOLUTION.

Look in Table II. against 40 and 50, and you will find the numbers 445 and 346 respectively, shewing that out of 445 persons living of 40 years of age, only 346 of them will be living at the age of 50; therefore the whole number of persons living at the beginning of this term, is to the number remaining alive at the end of it; so is 1 person living at the beginning, to $\frac{346}{445}$, his probability of remaining alive at the end of it.

Or thus, seeing there are 445 persons living at the age of 40, each of whom must either

D

live
r

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live to the age of 50 or die before; but by Table II. out of 445 living, there are but 346 attains to the age of 50, what probability has each to be amongst those then living? In this case 445 may be considered as the number of chances by which an event may either happen or fail; and 346 those by which it may happen, then the probability will be $\frac{346}{445}$ (Def. I. of Chance).

Or more generally thus; a person A years of age, wants to know the probability of his living t years longer, or attaining to the age $A+t$.

Let N = the number of persons living at the age A , by Table II.

n = the number living at the age $A+t$,
by the same Table, then will
 $\frac{n}{N}$, be the probability required.

QUESTION. II.

A person A years of age, wants to know how long he may reasonably expect to live.

SOLUTION.

SOLUTION.

Let N = the number of persons living at the age of A , by Table II.

x = the number of years fought.

n = the number of persons living at the

age $A+x$, then will $\frac{n}{N}$ be the probability of his living x years longer, or attaining to the age $A+x$; but by the question this probability is equal to that of his being dead in x years longer, and the sum of these two probabilities is $=1$, therefore $\frac{n}{N} = \frac{1}{2}$, and $n = \frac{N}{2}$, that is, take the number in Table II. opposite to the given age A , and divide it by 2, with this quotient, applied to the same table, find the number (or nearest if it cannot be found) against which stands the age $A+x$.

EXAMPLE I.

If $A=40$, then (Table II.) $N=445$, and $n=222$, which find in the same table, and opposite thereto you have $6=A+x$, therefore $x=22$ years.

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EXAMPLE II.

If $A=36$, then (Table II.) $N=481$, and $n=240$, find this in the same table, or the nearest thereto, and opposite to this number, is found $60=A+x$, therefore $x=24$ years.

QUESTION III.

To find the difference of insurance upon different lives ; as between 30 and 50.

SOLUTION.

By Table II. find the number living against 30, and also the decrement in the next column, and likewise against 50 do the same, then it is 531 to 8, that a person 30 years of age, does not die in a year, and only 346 to 11, that a person 50 years does not die in a year : Or, divide the first by 8, and the last by 11, it will be 66 to 1, that a person 30 years of age does not die in one year, and only 31 to 1, that a person 50 years of age does not die in a year. Therefore the difference of insurance ought to be as 66 to 31.

QUESTION

QUESTION IV.

Suppose the decrement of life equal *, and the utmost probable extent of life 86; to determine the expectation as before, without the help of tables.

SOLUTION.

Let x = the number of years fought.

A = the given age.

$86 - A = C$, which call the complement of life.

Then the probability of living x years will

be $\frac{x}{c}$, and that of his being dead before

will be $1 - \frac{x}{c}$, or $\frac{c-x}{c}$, but these probabilities from the nature of the question are

equal, i. e. $\frac{c-x}{c} = \frac{x}{c}$ therefore $x = \frac{c}{2}$.

* Mr. De Moivre was the first who made this supposition, and it being found so nearly conformable to Dr. Halley's table of observations, formed from the Bills of Mortality of Breslaw in Silesia, as not to create any material error, and at the same time greatly facilitate every calculation thereon; it has therefore been adopted as a principle, known by the name of De Moivre's Hypothesis.

THE VALUE OF LIFE. ANNUITIES.

EVERY calculation, relative to annuities on life, depend on these two principles, viz. the Interest which money bears, and the Probability of the duration of Life.

Therefore, in order to establish a society of annuitants for the benefit of age (such as the Laudable or Amicable Societies), on these rational principles, it will be necessary to put the following general question, which, when answered in every particular case, will furnish tables of admission for that purpose.

QUESTION.

A person A years of age, wants to purchase an annuity of B pounds a year, for what may happen to remain of his life after C years of age, subject in the mean time to failure, should his life fail; what is the value of such an annuity in *present money*, and also in *annual payments* till he attains to C years of age, reckoning interest at the rate of r per cent?

AN-

ANSWER.

Let N = the number of persons living at the given age A , by any table of observations.

n = those living at the age of C , by the same table.

y = the number of years the given age A wants of attaining to the age of C .

P = the present worth of 11. pound to be received at the end of y years, at the rate of r compound interest.

V = the value of a life A years of age, by Table III. at the same rate of interest.

v = the value of a life $A+y$, or C years of age, by the same table, and at the same rate of interest.

1. Then; if the person was entitled * to the annuity B immediately, it must evidently be

* "Was entitled to the annuity B ," ought here, and throughout the whole of these calculations, to be understood, that the Claimant only becomes possessed of his right, or claims his title to the said annuity; but does not begin to receive it till a year after.

worth

worth v years purchase, or $B \times v$ pounds; but as he cannot be entitled to it until after the expiration of y years, he must therefore be allowed the proper discount for his ready money y years, which will, by taking off the discount, leave BP^y for the value of the annuity; this value would be just, was the purchaser sure of living y years; but the probability of this event happening is $\frac{n}{N}$, therefore this value BP^y ought to be diminished in proportion to the probability of his living to receive it, after which it will then become $B \times \frac{P^y n}{N}$, the real value that ought to be given for such an annuity in *present money*.

2. To find the value of this Annuity in *annual payments* till the given age A attains to the age of $A+y$. It is evident that such *annual payment* must be made for y years, if the given life continues so long, as would afterwards be just sufficient to afford the proposed annuity for the remainder of the life, but the value of an annuity for y years, subject to failure, should the life fail, is evidently $V - \frac{P^y n}{N}$, this therefore being the number of years purchase that ought to be given for an annuity of 1l. to continue y years

years, if the given life, now A years, should last so long, and $\frac{P_{nv}}{N}$ being the *present value* of an annuity of 1l. for the remainder of a life, now A years, after attaining to C , it evidently follows, that the value of this annuity in *annual payments*, till the given life, A years, attains to C , is $\frac{P_{nv}}{N}$ divided by $V - \frac{P_{nv}}{N}$, or $\frac{P_{nv}}{NV - P_{nv}} =$ the value of 1l. annuity, in *annual payments*; which multiply by B , will give $B \times \frac{P_{nv}}{NV - P_{nv}}$ for the required value in *annual payments*.

Hence, you have these two general Theorems.

1. $B \times \frac{P_{nv}}{N} =$ the value of the annuity B in *present money*.

2. $B \times \frac{P_{nv}}{NV - P_{nv}} =$ the value of the annuity B in *annual payments*.

By which, making $A=1, 2, 3, 4 \dots \&c.$ to the utmost probable extent of life, $B=1$, $C=50$, and $r=4, 3, \&c.$ Tables may be formed for all ages, shewing the value of 1l. annuity in *present money*, and also in *annual pay-*

D

ments,

ments, at any rate of interest. But this being so easy as to render any further instruction thereon unnecessary, I shall content myself with substituting for *A*, at the interval of every 5 years, from 1 to 60, and for *r*, 2 and 3, which form the following

TABLE (marked A).

Shewing the value of 1*l.* annuity in *present money*, and also in *annual payments*.

Age.	Value of 1 <i>l.</i> annuity in present mo- ney at 4 per cent.	Value of 1 <i>l.</i> annuity in present mo- ney at 3 per cent.	Value of 1 <i>l.</i> annuity in annual pay- ments at 4 per cent.	Value of 1 <i>l.</i> annuity in annual pay- ments at 3 per cent.
1	,552	,986	,0329	,055
5	,918	1,559	,0551	,087
10	1,237	2,015	,0790	,113
15	1,583	2,444	,1068	,146
20	2,023	2,989	,1459	,193
25	2,596	3,644	,2041	,259
30	3,373	4,508	,2982	,366
35	4,448	5,667	,4666	,559
40	5,958	7,232	,8231	,950
45	5,091	6,115	,7041	,803
50	4,260	5,061	,6013	,679
55	3,389	3,975	,4941	,551
60	2,404	2,784	,3635	,401

If

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If Table (A) be multiplied by 24, agreeable to the annuity promised by the Laudable Society, we shall have

TABLE (B).

Shewing the value of an annuity of 24l. in *present money*, and also in *annual payments*, at the rates of 4 and 3 per cent.

Age.	Value of 24l. annuity in present money at 4 per cent.	Value of 24l. annuity in present money at 3 per cent.	Value of 24l. annuity in annual payments at 4 per cent.	Value of 24l. annuity in annual payments at 3 per cent.
1	13,246	23,664	,7896	1,320
5	22,032	37,416	1,3224	2,088
10	29,688	48,360	1,8960	2,712
15	37,992	58,656	2,5632	3,504
20	48,552	71,736	3,5016	4,632
25	62,304	87,456	4,8984	6,216
30	80,952	108,192	7,1568	8,784
35	106,752	136,008	11,1984	13,416
40	142,992	173,568	19,7544	22,800
45	122,184	146,760	16,8984	19,272
50	102,240	121,464	14,4312	16,296
55	81,336	95,400	11,8584	13,224
60	57,696	66,816	8,7240	9,624

THE VALUE OF

If Table (A) be multiplied by 26, agreeable to the annuity promised by the Amicable Society, we have

TABLE (C).

Shewing the value of an annuity of 26l. in *present money*, and also in *annual payments*, at the rates of 4 and 3 per cent.

Age.	Value of 26l. annuity in present money at 4 per cent.	Value of 26l. annuity in present money at 3 per cent.	Value of 26l. annuity in annual payments at 4 per cent.	Value of 26l. annuity in annual payments at 3 per cent.
1	14,358	25,657	,850	1,430
5	23,867	40,534	1,430	2,262
10	32,159	52,390	2,054	2,938
15	41,177	63,544	2,776	3,796
20	52,612	77,714	3,796	5,018
25	67,512	94,744	5,304	6,734
30	87,713	117,208	7,748	9,516
35	115,650	147,342	12,131	14,534
40	154,909	188,032	21,398	24,700
45	132,381	158,990	18,304	20,878
50	110,764	131,586	15,626	17,654
55	88,124	103,350	12,844	14,338
60	62,504	72,384	9,451	10,426

But

LIFE ANNUITIES. 29

But the Amicable Society have lately taken the state of their fund into consideration, and compared it with the number of claimants that will soon be upon them, and find, that it will not admit of more than 6 pounds annuity, instead of 26; therefore, if Table (A) be multiplied by 6, it will form the following Table, adapted to this alteration.

TABLE (D).

Shewing the value of an annuity of 6l. in *present money*, and also in *annual payments*, at the rates of 4 and 3 per cent.

Age.	Value of 6l. annuity in present money at 4 per cent.	Value of 6l. annuity in present money at 3 per cent.	Value of 6l. annuity in annual payments at 4 per cent.	Value of 6l. annuity in annual payments at 3 per cent.
1	3,312	5,916	,1974	,330
5	5,508	9,354	,3306	,522
10	7,422	12,090	,4740	,678
15	9,498	14,664	,6408	,876
20	12,138	17,934	,8754	1,158
25	15,576	21,864	1,2246	1,554
30	20,238	27,048	1,7892	2,196
35	26,688	34,002	2,7996	3,354
40	35,748	43,392	4,9386	5,700
45	30,546	36,690	4,2246	4,818
50	25,560	30,366	3,6078	4,074
55	20,334	23,850	2,9646	3,306
60	14,424	16,704	2,1810	2,406

In

In the preceding part of this work, it has been shewn how to calculate the value of the proposed annuity either in *ready money*, or *annual payments*; and also given by inspection from the tables. It remains now to find this value *partly in admission money*, and *partly in annual payments*, till the given life attains to the given age where the proposed annuity commences. This is had by the following proportion.

As the value of the proposed annuity in *present money*, is to that value in *annual payments*; so is the *present money* paid on admission, to a fourth proportional,

Which fourth proportional deducted from the value in *annual payments*, leaves the *annual payment* that is to be made, over and above the admission money.

Should any one yet remain in doubt about the truth of this matter, let $B \times \frac{Pvn}{N} = E$, the value of the annuity of B pounds in *present money*, $B \times \frac{Pvn}{NV - Pvn} = F$, the value of the same annuity in *annual payments*, as found before (agreeable to the notation, in the solution of the
general

general question) ; and let G = the admiffion money, according to the abftracts of either of thefe focieties. Then if E pounds in *ready money*, be equivalent to F pounds in *annual payments* for any given time, what will G pounds in *ready money*, be equivalent to in *annual payments* for the fame time, i. e. $E : F :: G : \frac{FG}{E}$. But E *ready money*, is equal in value to F in *annual payments*, and G *ready money*, is equal in value to $\frac{FG}{E}$ in *annual payments* for the given time ; therefore $E - G$ *ready money*, is equal to $F - \frac{FG}{E}$ in *annual payments* for the fame given time, which will be the *annual payment*, over and above the admiffion money G .

So, if this procefs be applied to Table B, and G put equal to the admiffion money againft the refpective ages in the abftract of the Laudable Society, we fhall have the following

TABLE

TABLE (E).

Shewing *what annual payment*, over and above the admission money, ought to be made for an annuity of 24l.

Age.	Admission money as per abstract.		Value of 24l. annuity in annual payments with admission money at 4 per cent.	Value of 24l. annuity in annual payments with admission money at 3 per cent.	Value of the admission money (in the first column) in annual payments at 4 per cent.	Value of the admission money in annual payments at 3 per cent.
1	1	1	5,727	1,262	5062	5058
5	3	3	1,133	1,913	5189	5175
10	5	5	1,561	2,418	5335	5294
15	8	8	1,997	3,003	5566	5501
20	11	11	2,669	3,887	5832	5745
25	19	19	3,330	4,799	1,568	1,417
30	33	12	4,186	6,057	2,970	2,727
35	58	16	5,019	7,616	6,179	5,800
40	105	00	5,249	9,008	14,505	13,792
45	105	00	2,377	5,484	14,521	13,788
50	59	17	5,984	8,267	8,447	8,029
55	12	12	10,021	11,478	1,837	1,746
60	0	00	8,724	9,624	0,000	0,000

By

LIFE ANNUITIES. 33

By the same process with Table (marked C), and G put equal to the admission money against the respective ages, in the abstract of the Amicable Society, we shall have the following

TABLE (F).

Shewing *what annual payment*, over and above the admission money as there specified, ought to be made for an annuity of 26l.

Age.	Admission money as per abstract.		Value of 26l. annuity in annual payments with admission money at 4 per cent.	Value of 26l. annuity in annual payments with admission money at 3 per cent.	Value of the admission money in annual payments at 4 per cent.	Value of the admission money in annual payments at 3 per cent.
	l.	s.				
1	0	0	,850	1,430	,000	,000
5	0	0	1,430	2,262	,000	,000
10	0	10	2,022	2,910	,031	,028
15	0	15	2,725	3,751	,050	,044
20	1	0	3,724	4,953	,072	,064
25	6	6	4,809	6,286	,495	,447
30	14	14	6,450	8,322	1,294	1,193
35	24	0	9,614	12,167	2,517	2,367
40	31	10	17,047	20,562	4,351	4,137
45	21	0	15,400	18,121	2,904	2,757
50	10	0	14,215	16,312	1,411	1,341
55	1	15	12,589	14,096	,182	,173
60	1	1	9,270	10,253	,158	,151

F

But

But from a late resolution of the Amicable Society, that 6l. instead of 26l. shall be the annuity paid to claimants, it will be necessary to proceed with Table (marked D), and G the admission money (as per said abstract) in the same way, which will furnish the following

TABLE (G).

Shewing *what annual payment*, over and above the admission money, ought to be made for an annuity of 6l.

Age.	Admission money as per abstract.		Value of 6l. annuity in annual payments with admission money at 4 per cent.	Value of 6l. annuity in annual payments with admission money at 3 per cent.	Value of the admission money in annual payments at 4 per cent.	Value of the admission money in annual payments at 3 per cent.
	<i>l.</i>	<i>s.</i>				
1	0	0	,1974	,330	,0000	,0000
5	0	0	,3306	,522	,0000	,0000
10	0	10	,4421	,650	,0319	,0280
15	0	15	,5902	,831	,0506	,0448
20	1	0	,8032	1,094	,0722	,0645
25	6	6	,7293	1,107	,4953	,4477
30	14	14	,4946	1,003	1,2946	1,1934
35	24	0	,2820	,987	2,5176	2,3673
40	31	10	,5869	1,562	4,3517	4,1378
45	21	0	1,3203	2,061	2,9043	2,7576
50	10	0	2,1963	2,733	1,4115	1,3416
55	1	5	2,7824	3,133	,1822	,1732
60	1	1	2,0223	2,255	,1587	,1512

If

It has been shewn by general Theorems, how to find the true value of the annuity promised by either of these societies, according to any rate of interest and contingency of life; either in a single sum *present money*, in *annual payments*; or *partly in present money*, and *partly in annual payments*; and tables deduced from them particularly adapted to the several ways by which these societies admit their members. It follows now to make a comparison between the true value, and that imaginary one, as stated in their printed abstracts.

Comparison

Comparison of the LAUDABLE.

Age.	TABLE B.		Annual payments without admission as per abstract.	TABLE E.		Annual payments with admission as per abstract.
	4 percent.	3 percent.		4 percent.	3 percent.	
5	1,32	2,08	1,60	1,13	1,91	1,20
10	1,89	2,71	2,10	1,56	2,41	1,45
15	2,56	3,50	2,70	1,99	3,00	1,70
20	3,50	4,63	3,50	2,67	3,88	2,20
25	4,89	6,21	5,00	3,33	4,79	2,75
30	7,15	8,78	7,35	4,18	6,05	3,55
35	11,19	13,41	12,00	5,02	7,61	4,85
40	19,75	22,80	22,00	5,25	9,00	6,70
45	16,89	19,27	22,00	2,38	5,48	6,70
50	14,43	16,29	16,50	5,98	8,26	6,70
55	11,85	13,22	10,25	10,02	11,47	6,70

From this comparison it appears, that the second table of admission in the abstract of the Laudable Society is nearly conformable to table B, at 4 per cent. as far as the age of 30, and from that age to 55, it inclines more to 3 per cent; so that if you reckon interest at 4 per cent, for all ages to 30, and 3 per cent, for all above, or $3\frac{1}{2}$ per cent, on the whole; and suppose this society consists of nearly an equal number of all ages from 5 to 55, constantly kept up, it may subsist with the same probability of permanency, as if each member had paid their proper quota; for these paying more than their right, will just compensate for those paying less.

The same observation may be made on their first table of admission, compared with Table E, with this difference only, that the conformity (on the mean of every age) inclines throughout to 4 per cent. So that if interest be reckoned at 4 per cent, and suppose that an equal number of members at all ages be admitted from 5 to 55, and so kept up; this society will, in this case, be on as permanent a foundation as if each individual had paid his just quota, for the reason before assigned.

Com-

Comparison of the AMICABLE.

Age.	TABLE D.		Annual pay- ments without ad- mission as per abtract.	TABLE G.		Annual pay- ments with admission as per abtract.
	4 per cent.	3 per cent.		4 per cent.	3 per cent.	
5	,33	,52	,60	,33	,52	,60
10	,47	,67	,90	,44	,65	,85
15	,64	,87	1,20	,59	,83	1,10
20	,87	1,15	1,60	,80	1,09	1,35
25	1,22	1,55	2,10	,72	1,10	1,80
30	1,79	2,19	4,00	,49	1,00	2,60
35	2,80	3,35	6,90	,28	,98	3,80
40	4,93	5,70	13,00	,58	1,56	6,00
45	4,22	4,81	11,60	1,32	2,06	6,00
50	3,60	4,07	9,00	2,19	2,73	4,60
55	2,96	3,30	5,20	2,78	3,13	3,70

From this comparison it appears, that the second table of admission, on the abstract of the Amicable Society, is nearly double to Table D, under 4 per cent. as far as 30; and from that age to 55, more than double the same table under 3 per cent. Therefore, if you reckon interest at $3\frac{1}{2}$, or near 4 per cent. and suppose an equal number of members of every age from 5 to 55, all admitted on these terms, and constantly kept up, this society would be able to pay 12 l. annuity to claimants.

But with respect to the first table of admission, as given on their abstract, it is not so obvious in the form that it now stands, to discover, by any comparison, more than its being abundantly sufficient to pay an annuity of 6 l. and for this reason, the admission money being in the more advanced ages, so very considerable, with respect to the remaining part of the value to be made up in *annual payments*, as to render them in no wise similar to each other. Therefore, in order to make this comparison more conspicuous, you must add the value of the admission money in *annual payments*, to the *annual payments* over and above this admission money, as specified in the table; and then compare it

it with Table D as before : by which comparison it will be found, *on a supposition* that an equal number of members of every age from 5 to 55, had all been admitted by this table, and so kept up, that the society would have been able to pay 11 l. reckoning interest at 4 per cent. or 9 l. interest at 3 per cent. to claimants.

But lest this should not be sufficiently evident to every person, find, by actual calculation, *what annuity* every member is justly entitled to, according to the money he has paid ; whether wholly in *annual payments*, or *partly in admission* and *partly in annual payments* ; and then take the mean amongst the whole, for the annuity that the society can afford to pay.

This annuity is thus found :

As the value found in Table B against the given age, and under the given rate of interest, is to 24 l. so is the value in the second table of their abstract against the given age, to the annuity required (for the Laudable Society).

If the required annuity be paid for, *partly in admission* and *partly in annual payments*, as by table
the

LIFE ANNUITIES. 41

the first in their abstract, find the value of the admiffion money *in annual payments* by Table E, and add this value to the *annual payment*, over and above the admiffion, as specified in the said abstract. Then work by the same proportion, and make this sum the third term; and you have the value of the annuity agreeable to this table of admiffion.

What has been said respecting the Laudable Society in this matter, is equally applicable to the Amicable, by using Tables C and F for 26l. annuity, or D and G for 6l. with the tables on the abstract of this society.

1	0.25	1.25	1.50
2	0.50	2.50	3.00
3	0.75	3.75	4.50
4	1.00	5.00	6.00
5	1.25	6.25	7.50
6	1.50	7.50	9.00
7	1.75	8.75	10.50
8	2.00	10.00	12.00
9	2.25	11.25	13.50
10	2.50	12.50	15.00
11	2.75	13.75	16.50
12	3.00	15.00	18.00
13	3.25	16.25	19.50
14	3.50	17.50	21.00
15	3.75	18.75	22.50
16	4.00	20.00	24.00
17	4.25	21.25	25.50
18	4.50	22.50	27.00
19	4.75	23.75	28.50
20	5.00	25.00	30.00

G

This

This operation repeated at the interval of every five years will furnish the following

TABLE H (for the LAUDABLE).

Shewing the annuity that every member of this society has a just right to expect, according to the money he has paid; either wholly in annual payments, or partly in admission and partly in annual payments, at the rates of 4 and 3 per cent.

Age.	Without Admission .		With Admission.	
	4 per cent.	3 per cent.	4 per cent.	3 per cent.
5	29,1	18,4	25,0	15,8
10	25,4	18,6	22,6	15,4
15	25,3	18,5	21,1	15,0
20	24,0	18,1	20,7	15,2
25	24,5	19,3	21,1	16,0
30	24,6	20,0	21,8	17,1
35	25,7	21,4	23,6	19,0
40	26,7	23,1	25,7	21,5
45	31,2	27,4	30,1	25,5
50	27,5	24,3	25,1	21,6
55	20,7	18,6	17,2	15,3

But

Here it may be observed, that if the columns under 4 and 3 per cent. without admiffion, be added up, and the average or mean between them taken, it will be 23l. 6s.; also if the other columns under 4 and 3 per cent. with admiffion, be added, and the mean of these taken feperately, we fhall have 23l. 2s., and 18l. refpectively. Shewing, that if an equal number of all ages from 5 to 55, be admitted on the terms in their fecond table, and reckoning intereft at $3\frac{1}{2}$ per cent. or on thofe of their firft table, intereft at 4 or 3 per cent. this fociety would be able to pay an annuity of 23l. 6s. 23l. 2s. or 18l. refpectively to claimants.

0.0	10.01	10.0	10.01	
1.0	9.99	9.9	9.99	
2.0	9.97	9.8	9.97	
3.0	9.94	9.7	9.94	
4.0	9.91	9.6	9.91	
5.0	9.88	9.5	9.88	
6.0	9.85	9.4	9.85	
7.0	9.82	9.3	9.82	
8.0	9.79	9.2	9.79	
9.0	9.76	9.1	9.76	
10.0	9.73	9.0	9.73	
11.0	9.70	8.9	9.70	
12.0	9.67	8.8	9.67	
13.0	9.64	8.7	9.64	
14.0	9.61	8.6	9.61	
15.0	9.58	8.5	9.58	
16.0	9.55	8.4	9.55	
17.0	9.52	8.3	9.52	
18.0	9.49	8.2	9.49	
19.0	9.46	8.1	9.46	
20.0	9.43	8.0	9.43	
21.0	9.40	7.9	9.40	
22.0	9.37	7.8	9.37	
23.0	9.34	7.7	9.34	
24.0	9.31	7.6	9.31	
25.0	9.28	7.5	9.28	
26.0	9.25	7.4	9.25	
27.0	9.22	7.3	9.22	
28.0	9.19	7.2	9.19	
29.0	9.16	7.1	9.16	
30.0	9.13	7.0	9.13	
31.0	9.10	6.9	9.10	
32.0	9.07	6.8	9.07	
33.0	9.04	6.7	9.04	
34.0	9.01	6.6	9.01	
35.0	8.98	6.5	8.98	
36.0	8.95	6.4	8.95	
37.0	8.92	6.3	8.92	
38.0	8.89	6.2	8.89	
39.0	8.86	6.1	8.86	
40.0	8.83	6.0	8.83	
41.0	8.80	5.9	8.80	
42.0	8.77	5.8	8.77	
43.0	8.74	5.7	8.74	
44.0	8.71	5.6	8.71	
45.0	8.68	5.5	8.68	
46.0	8.65	5.4	8.65	
47.0	8.62	5.3	8.62	
48.0	8.59	5.2	8.59	
49.0	8.56	5.1	8.56	
50.0	8.53	5.0	8.53	
51.0	8.50	4.9	8.50	
52.0	8.47	4.8	8.47	
53.0	8.44	4.7	8.44	
54.0	8.41	4.6	8.41	
55.0	8.38	4.5	8.38	

G 2

Again

Again, proceed in this way with Tables D and G, we shall have the following

TABLE J (for the AMICABLE).

Shewing the annuity that every member of this society has a just right to expect, according to the money he has paid; either wholly in annual payments, or partly in admission and partly in annual payments, at the rates of 4 and 3 per cent.

Age.	Without Admission.		With Admission.	
	4 per cent.	3 per cent.	4 per cent.	3 per cent.
5	10,91	6,92	10,91	6,9
10	11,49	8,05	11,23	7,7
15	11,25	8,27	10,78	7,8
20	11,03	8,34	9,80	7,3
25	10,32	8,12	11,24	8,6
30	13,40	10,95	13,03	11,3
35	14,78	12,35	13,50	11,0
40	15,82	13,68	12,59	10,6
45	16,49	14,47	12,65	10,9
50	15,00	13,26	10,01	8,8
55	10,54	9,45	7,86	7,3

From

From this table it may be observed, by adding the columns and taking the mean as before (for the Laudable) we shall find, that if an equal number of members of all ages from 5 to 55, be admitted by their second table, this society would be able to pay an annuity of 12l. or 10l. 7s. according as you reckon interest at 4 or 3 per cent. But if they were admitted by the first table, it would only admit of 11l. 4s. 6d. or 9l. according to the rates of 4 or 3 per cent.

Here a question will naturally suggest itself to the Reader, how this should be possible; since a committee of Gentlemen (furnished with the proper data to enquire into the state of this society) have found that it cannot pay more than 6l. annuity. In answer to this seeming contradiction it will be sufficient to say, that this calculation takes it for granted, that every member, which compose this society, has been admitted on the terms specified in one or other of the tables that now appear on their abstracts; and not only so, but an equal number of every age is also necessary to preserve this mean, on account of the great irregularity that subsists in the tables of admission. But the great cause of this vast disparity, between the mean annuity here found, and that fixed
by

by the above Gentlemen, must evidently arise from many of their members being admitted on much *lower terms* than are now specified on their abstract. For at the present rate of admission, on the most reasonable table, and at the low rate of 3 per cent. interest, a member, at any age, pays more than equivalent to the annuity of 6l. and by the same table, and the same rate of interest, at some ages, pays almost three times that value. Whether the Laudable Society be altogether free from this evil, is a question, for want of data that cannot be determined here; but it is not likely at most, to be so very predominant, since their tables of admission are much more adequate to the annuity they promise.

Having calculated the real value of the respective annuities promised, by these societies, in all the various ways by which they are granted, and formed tables from them, whereby this value is had by inspection; and then compared it with that fictitious value on their abstracts, by which not only the insufficiency, but also the inequality of their schemes are abundantly manifest. After which, it becomes indispensably necessary to give some instruction to these who wish to be guided by accuracy and truth, how they may reform themselves, and make
proper

proper compensation, or restitution, for what each may have paid too little or too much, and this may be done as follows: find the whole amount that each member has paid to the present time, at the rate of compound interest, which the fund of that society has been improved at; and also the amount that ought to have been paid; subtract the less from the greater, and the difference will be the compensation, or restitution to be made, according as it may happen to be more or less than equivalent to the promised annuity.

I shall now conclude this subject with the following questions illustrating the whole, and *very interesting* to every member of these societies, or any other person desirous to become one.

QUESTION I.

A person wishes to become a member of the Laudable Society, but wants to know at what age, and by which of their tables, it would be most to his advantage to be admitted, reckoning interest at 4 per cent.

ANSWER.

ANSWER.

Look in Table H under 4 per cent. in either part, and find the least annuity (which is 17,2) at the top you have the table (with admiffion) and in the first column oppofite, the required age 55; fhewing that a person 55 years of age, being admitted a member by their first table, will be entitled to an annuity of 24l. in the fpace of 10 years; whereas, he will then but have paid an equivalent value to an annuity of of 17l. 4s.

QUESTION. II.

Let the fame thing be required as before, but intereft at the rate of 3 per cent.

ANSWER.

By Table H, you find their table *with admiffion*, and 15, the moft advantageous table and age.

QUESTION III.

A person being defirous to become a member of the Amicable Society, wants to know which of their tables are moft advantageous for him

him to be admitted by, and also at what age, interest at 4 per cent.

ANSWER.

Look in Table J, and you will find 7,86 under 4 per cent. in the Table *with admission*, and opposite thereto 55, the required age; shewing, as before, that a person 55 years of age, being admitted a member of this society, will, in 10 years, be entitled to an annuity of 6l. for the remainder of his life; but *observe*, that he will then have paid an equivalent value to an annuity of 7l. 17s. 2½d.

QUESTION IV.

Let the same (as in the last question) be required, but interest at the rate of 3 per cent.

ANSWER.

By Table J, you find 5 the age most advantageous by either table (both being alike for any age under 10) where, *again it ought to be observed*, that a person 5 years of age, being admitted a member at the low rate of 3 per cent. interest, and the most advantageous time of life,

H will

will, by the time that he attains to 50, have paid an equivalent to an annuity of 6l. 18s. 5d.

I presume the Reader need not be told, that any advantage gained by one, or any number of members in a society, is so much lost by the remaining part of that society, *et vice versa*.

But it may not be improper to reverse these last two questions.

QUESTION V.

Which table is the most advantageous for the Amicable Society to admit a member, and at what age, reckoning interest at 4 per cent ?

ANSWER.

In Table J, under 4 per cent. and table *without admission*, you find the highest annuity 16,49 and opposite thereto 45, shewing that a person 45 years of age admitted a member, will, in 10 years be entitled to an annuity of 6l. for which the society has received of him an equivalent to pay an annuity of 16l. 9s. 9d.

QUESTION

QUESTION VI.

Let the same (as in the last question) be required, but interest at the rate of 3 per cent.

ANSWER.

In Table J, under 3 per cent. and Table *without admission*, you have 14.47 and the age as before 45; so that a person 45 years of age, being admitted a member, will, in 10 years, be entitled to an annuity of 6l. for which the society has received of him an equivalent to an annuity of 14l. 9s. 5d.

From what has been proved (in the answers to these last four questions) sufficiently confirms a hint dropt before on page 46, that every member of the Amicable Society, who has been admitted by any table now existing on their abstracts, will, before he has any claim on the society, have paid more than equivalent to this annuity, now fixed at 6l.

But since the authority that fixed this, has been so candid as to favour the dissatisfied

members with the salvo of being permitted to receive their money out (under certain restrictions) and to withdraw themselves from the society. I have been more particularly attentive to this point, it being a matter of such importance to every person concerned, as will excuse my prolixity in proving and explaining the advantage or disadvantage, accruing to every person from his remaining a member of the society, or withdrawing himself from it; and though these may appear self-evident to many of my readers from Table J, yet it is supposed there are some, less acquainted with enquiries of this nature, and yet equally concerned in the result; it is to these that (of the two evils) I have chose the redundant rather than the laconic.

I shall add one question more, for the use of such members as have been admitted on *lower terms* than these now specified in the tables of their present abstract, as a guide for every person to calculate for himself, agreeable to his own terms of admission.

QUESTION

QUESTION VII.

Suppose a person 29 years of age, admitted a member of the Amicable Society, on paying 1l. 18s. admission money, and 2l. 4d. in annual payments; now wants to know whether it would be most to his advantage (under the present circumstance) to continue a member, or withdraw himself from the society, interest at 4 per cent?

ANSWER.

By the notation in answer to the general question on page 23, you have $A=29$, $B=6$, $y=50-32=21$; therefore, $N=539$, $n=346$ (Table II.) $P=,4388$ (Table I.) $V=14,816$ and $v=11,344$ (Table III.) which values substitute in the first general Theorem $B \times \frac{Pnv}{N} = 6 \times \frac{,4388 \times 346 \times 11,344}{539} = 19,17 =$ the value in *present money*. Then this value divided by $V - \frac{Pnv}{N} (=14,816 - 3,195 = 11,621)$ gives 1,65 (page 25.) the value in *annual payments*. Therefore $19,17 : 1,9 :: 1,65 : ,163$ by the direction on page 30. the value of the admission in *annual payments*,

payments, which subtract from the whole value in *annual payments* (1,65) leaves 1,487, or 1l. 9s. 9d. for the *annual payment*, over and above the admission that he ought to pay for 6l. annuity. But by the question, he pays 2l. os. 4d. over and above the admission (1l. 18s.) so that in this case a person so admitted, would pay 10s. 7d. annually more than his just right.

A C O L-

A
COLLECTION

OF

TABLES;

NECESSARY FOR THE CALCULATION

OF

ANNUITIES ON LIFE.

COLLECTION

OF

TABULAR

NECESSARY FOR THE COLLECTION

OF

ANALYTICAL

TABLE I.

The present value of 1l. to be received at the end of any number of years, not exceeding 100; discounting at the rates of 3, 4 and 5 per cent. compound interest.

Years.	3 per cent.	4 per cent.	5 per cent.
1	,970874	,961538	,952381
2	,942596	,924556	,907029
3	,915142	,888996	,863838
4	,888487	,854804	,822702
5	,862609	,821927	,783526
6	,837484	,790315	,746215
7	,813092	,759918	,710681
8	,789409	,730690	,676839
9	,766417	,702587	,644609
10	,744094	,675564	,613913
11	,722421	,649581	,584679
12	,701380	,624597	,556837
13	,680951	,600574	,530321
14	,661118	,577475	,505068
15	,641862	,555265	,481017
16	,623167	,533908	,458112
17	,605016	,513373	,436297
18	,587395	,493628	,415521
19	,570286	,474642	,395734
20	,553676	,456387	,376889

Continuation of TABLE I.

Years.	3 per cent.	4 per cent.	5 per cent.
21	,537549	,438834	,358942
22	,521893	,421955	,341850
23	,506692	,405726	,325571
24	,491934	,390121	,310068
25	,477606	,375117	,295303
26	,463695	,360689	,281241
27	,450189	,346817	,267848
28	,437077	,333477	,255094
29	,424346	,320651	,242946
30	,411987	,308319	,231377
—	—	—	—
31	,399987	,296460	,220359
32	,388337	,285058	,209866
33	,377026	,274094	,199873
34	,366045	,263552	,190355
35	,355383	,253415	,181290
36	,345032	,243669	,172657
37	,334983	,234297	,164436
38	,325226	,225285	,156605
39	,315754	,216621	,149148
40	,306557	,208289	,142046
—	—	—	—
41	,297628	,200278	,135282
42	,288959	,192575	,128840
43	,280543	,185168	,122704

Continuation of TABLE I.

Years.	3 per cent.	4 per cent.	5 per cent.
44	,272372	,178046	,116864
45	,264439	,171198	,111297
46	,256737	,164614	,105997
47	,249259	,158283	,100949
48	,241999	,152195	,096142
49	,234950	,146341	,091564
50	,228107	,140713	,087204
51	,221463	,135301	,083051
52	,215013	,130097	,079096
53	,208750	,125093	,075330
54	,202670	,120282	,071743
55	,196767	,115656	,068326
56	,191036	,111207	,065073
57	,185472	,106930	,061974
58	,180070	,102817	,059023
59	,174825	,098963	,056212
60	,169733	,095060	,053536
61	,164789	,091404	,050986
62	,159990	,087889	,048558
63	,155330	,084508	,046246
64	,150806	,081258	,044044
65	,146413	,078133	,041946
66	,142149	,075128	,039949

Continuation of TABLE I.

Years.	3 per cent.	4 per cent.	5 per cent.
67	,138009	,072238	,038047
68	,133989	,069460	,036235
69	,130086	,066788	,034509
70	,126297	,064219	,032866
71	,122619	,061749	,031301
72	,119047	,059374	,029811
73	,115580	,057091	,028391
74	,112214	,054895	,027039
75	,108945	,052784	,025752
76	,105772	,050754	,024525
77	,102691	,048801	,023357
78	,099700	,046924	,022245
79	,096796	,045120	,021186
80	,093977	,043384	,020177
81	,091240	,041716	,019216
82	,088582	,040111	,018301
83	,086002	,038569	,017430
84	,083497	,037085	,016600
85	,081065	,035659	,015809
86	,078704	,034287	,015056
87	,076412	,032968	,014339
88	,074186	,031700	,013657
89	,072027	,030481	,013006
90	,069928	,029309	,012387

Continuation of TABLE I.

Years.	3 per cent.	4 per cent.	5 per cent.
91	,067891	,028182	,011797
92	,065914	,027098	,011235
93	,063994	,026055	,010700
94	,062130	,025053	,010191
95	,060320	,024090	,009705
96	,058563	,023163	,009243
97	,056858	,022272	,008803
98	,055202	,021416	,008384
99	,053594	,020592	,007985
100	,052033	,019800	,007604

TABLE II.

Shewing the probabilities of the duration of life, as deduced by Dr. Halley, from observations on the Bills of Mortality of *Breslaw*, being a medium between London lives and those of other great towns in England.

Ages	Persons living.	Decr. of life.	Ages.	Persons living.	Decr. of life.
1	1000	145	24	573	6
2	855	57	25	567	7
3	798	38	26	560	7
4	760	28	27	553	7
5	732	22	28	546	7
6	710	18	29	539	8
7	692	12	30	531	8
8	680	10	31	523	8
9	670	9	32	515	8
10	661	8	33	507	8
11	653	7	34	499	9
12	646	6	35	490	9
13	640	6	36	481	9
14	634	6	37	472	9
15	628	6	38	463	9
16	622	6	39	454	9
17	616	6	40	445	9
18	610	6	41	436	9
19	604	6	42	427	10
20	598	6	43	417	10
21	592	6	44	407	10
22	586	7	45	397	10
23	579	6	46	387	10

Continuation of TABLE II.

Ages.	Persons living.	Decr. of life	Ages.	Persons living.	Decr. of life.
47	377	10	69	152	10
48	367	10	70	142	11
49	357	11	71	131	11
50	346	11	72	120	11
51	335	11	73	109	11
52	324	11	74	98	10
53	313	11	75	88	10
54	302	10	76	78	10
55	292	10	77	68	10
56	282	10	78	58	9
57	272	10	79	49	8
58	262	10	80	41	7
59	252	10	81	34	6
60	242	10	82	28	5
61	232	10	83	23	4
62	222	10	84	19	4
63	212	10	85	15	4
64	202	10	86	11	3
65	192	10	87	8	3
66	182	10	88	5	2
67	172	10	89	3	2
68	162	10	90	1	1

TABLE III.

Shewing the present value of an annuity of 1l. on a single life. according to Mr. De Moivre's hypothesis; and therefore nearly according to the probabilities of life at *Breslaw*.

Age.	3 per cent.	4 per cent.	5 per cent.
8	19,736	16,791	14,544
9	19,868	16,882	14,607
10	19,868	16,882	14,607
11	19,736	16,791	14,544
12	19,604	16,698	14,480
13	19,469	16,604	14,412
14	19,331	16,508	14,342
15	19,192	16,410	14,271
16	19,050	16,311	14,197
17	18,905	16,209	14,123
18	18,759	16,105	14,047
19	18,610	15,999	13,970
20	18,458	15,891	13,891
21	18,305	15,781	13,810
22	18,148	15,669	13,727
23	17,990	15,554	13,642
24	17,827	15,437	13,555

Continuation of TABLE III.

Years.	3 per cent.	4 per cent.	5 per cent.
25	17,664	15,318	13,466
26	17,497	15,197	13,375
27	17,327	15,073	13,282
28	17,154	14,946	13,186
29	16,979	14,816	13,088
30	16,800	14,684	12,988
—	—	—	—
31	16,620	14,549	12,855
32	16,436	14,411	12,780
33	16,248	14,270	12,673
34	16,057	14,126	12,562
35	15,864	13,979	12,449
36	15,666	13,829	12,333
37	15,465	13,676	12,214
38	15,260	13,519	12,091
39	15,053	13,359	11,966
40	14,842	13,196	11,837
—	—	—	—
41	14,626	13,028	11,705
42	14,407	12,858	11,570
43	14,185	12,683	11,431
44	13,958	12,504	11,288
45	13,728	12,322	11,142
46	13,493	12,135	10,992
47	13,254	11,944	10,837

Continuation of TABLE III.

Age.	3 per cent.	4 per cent.	5 per cent.
48	13,012	11,748	10,679
49	12,764	11,548	10,515
50	12,511	11,344	10,348
51	12,255	11,135	10,176
52	11,994	10,921	9,999
53	11,729	10,702	9,817
54	11,457	10,478	9,630
55	11,183	10,248	9,437
56	10,902	10,014	9,239
57	10,616	9,773	9,036
58	10,325	9,527	8,826
59	10,029	9,275	8,611
60	9,727	9,017	8,389
61	9,419	8,753	8,161
62	9,107	8,482	7,926
63	8,787	8,205	7,684
64	8,462	7,921	7,435
65	8,132	7,631	7,179
66	7,794	7,333	6,915
67	7,450	7,027	6,643
68	7,099	6,714	6,362
69	6,743	6,394	6,073
70	6,378	6,065	5,775

Continuation of TABLE III.

Age.	3 per cent.	4 per cent.	5 per cent.
71	6,008	5,728	5,468
72	5,631	5,383	5,152
73	5,246	5,029	4,826
74	4,854	4,666	4,489
75	4,453	4,293	4,143
76	4,046	3,912	3,784
77	3,632	3,520	3,415
78	3,207	3,111	3,034
79	2,776	2,707	2,641
80	2,334	2,284	2,235
81	1,886	1,850	1,816
82	1,429	1,406	1,384
83	0,961	0,950	0,937
84	0,484	0,481	0,476
85	0,000	0,000	0,000

TABLE IV.

Shewing the probabilities of the duration of life as deduced, by Mr. Simpson, from observations on the bills of mortality in London.

Ages.	Persons living.	Decr. of life.	Ages.	Persons living.	Decr. of life.
0	1000	320	21	355	5
1	680	133	22	350	5
2	547	51	23	345	6
3	496	27	24	339	6
4	469	17	25	333	6
5	452	12	26	327	6
6	440	10	27	321	6
7	430	8	28	315	7
8	422	7	29	308	7
9	415	5	30	301	7
10	410	5	31	294	7
11	405	5	32	287	7
12	400	5	33	280	7
13	395	5	34	273	7
14	390	5	35	266	7
15	385	5	36	259	7
16	380	5	37	252	7
17	375	5	38	245	8
18	370	5	39	237	8
19	365	5	40	229	7
20	360	5			

Continuation of TABLE IV.

Ages.	Persons living.	Decr. of life	Ages.	Persons living.	Decr. of life.
41	222	8	61	97	5
42	214	8	62	92	5
43	206	7	63	87	5
44	199	7	64	82	5
45	192	7	65	77	5
46	185	7	66	72	5
47	178	7	67	67	5
48	171	6	68	62	4
49	165	6	69	58	4
50	159	6	70	54	4
51	153	6	71	50	4
52	147	6	72	46	4
53	141	6	73	42	3
54	135	6	74	39	3
55	129	6	75	36	3
56	123	6	76	33	3
57	117	5	77	30	3
58	112	5	78	27	2
59	107	5	79	25	2
60	102	5	80	23	2

TABLE V.

Shewing the value of an annuity on a single life, according to the probabilities of life in London, by Mr. Simpson.

Age.	Years purchase at 3 per cent.	Years. purchase at 4 per cent.	Years purchase at 5 per cent.
6	18,8	16,2	14,1
7	18,9	16,3	14,2
8	19,0	16,4	14,3
9	19,0	16,4	14,3
10	19,0	16,4	14,3
11	19,0	16,4	14,3
12	18,9	16,3	14,2
13	18,7	16,2	14,1
14	18,5	16,0	14,0
15	18,3	15,8	13,9
16	18,1	15,6	13,7
17	17,9	15,4	13,5
18	17,6	15,2	13,4
19	17,4	15,0	13,2
20	17,2	14,8	13,0
21	17,0	14,7	12,9
22	16,8	14,5	12,7
23	16,5	14,3	12,6
24	16,3	14,1	12,4
25	16,1	14,0	12,3

Continuation of TABLE V.

Age.	Years purchase at 3 per cent.	Years purchase at 4 per cent.	Years purchase at 5 per cent.
26	15,9	13,8	12,1
27	15,6	13,6	12,0
28	15,4	13,4	11,8
29	15,2	13,2	11,7
30	15,0	13,1	11,6
31	14,8	12,9	11,4
32	14,6	12,7	11,3
33	14,4	12,6	11,2
34	14,2	12,4	11,0
35	14,1	12,3	10,9
36	13,9	12,1	10,8
37	13,7	11,9	10,6
38	13,5	11,8	10,5
39	13,3	11,6	10,4
40	13,2	11,5	10,3
41	13,0	11,4	10,2
42	12,8	11,2	10,1
43	12,6	11,1	10,0
44	12,5	11,0	9,9
45	12,3	10,8	9,8
46	12,1	10,7	9,7
47	11,9	10,5	9,5
48	11,8	10,4	9,4
49	11,6	10,2	9,3
50	11,4	10,1	9,2

Continuation of TABLE V.

Age.	Years purchase at 3 per cent.	Years purchase at 4 per cent.	Years purchase at 5 per cent.
51	11,2	9,9	9,0
52	11,0	9,8	8,9
53	10,7	9,6	8,8
54	10,5	9,4	8,6
55	10,3	9,3	8,5
56	10,1	9,1	8,4
57	9,9	8,9	8,2
58	9,6	8,7	8,1
59	9,4	8,6	8,0
60	9,2	8,4	7,9
61	8,9	8,2	7,7
62	8,7	8,1	7,6
63	8,5	7,9	7,4
64	8,3	7,7	7,3
65	8,0	7,5	7,1
66	7,8	7,3	6,9
67	7,6	7,1	6,7
68	7,4	6,9	6,6
69	7,1	6,7	6,4
70	6,9	6,5	6,2
71	6,7	6,3	6,0
72	6,5	6,1	5,8
73	6,2	5,9	5,6
74	5,9	5,6	5,4
75	5,6	5,4	5,2

T H E E N D.

E R R A T A.

Page

14, l. 3, for $\frac{2}{3}$ read $\frac{3}{6}$

19, l. 21, for 6= read 60=

21, l. 9, for =C, read =c,

ib. l. 6 of the note, add *depending* before *thereon*;

23, l. 8, dele *pound*.

26, l. 5, for 2 and 3, read 4 and 3,

53, l. 13, for 32 read 29

E R R A T A



